

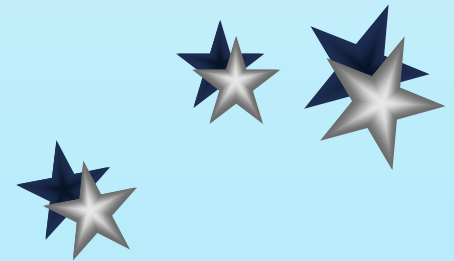


Federal IT R&D Supporting eBusiness and eGovernment

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Technology Research and Development**

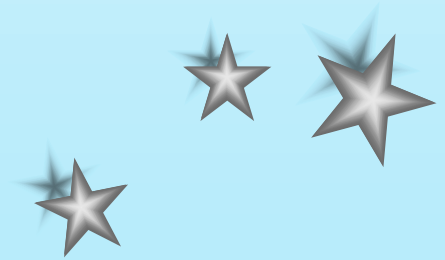
March 28, 2001





Overview

- **History of Federal IT R&D Program and purpose of involvement**
- **Organization of PITAC and IWG**
- **Review of PITAC Recommendations**
- **Summary**





Information Technology is one of the key factors driving progress in the 21st century

Information Technology is transforming the way we:

- Conduct commerce
- Conduct government
- Practice health care
- Design and build things
- Deal with the environment
- Communicate
- Deal with information
- Work
- Learn
- Conduct research

Information technology is creating a new infrastructure for business, scientific research, and social interaction





The Federal government plays a critical role in supporting fundamental IT R&D

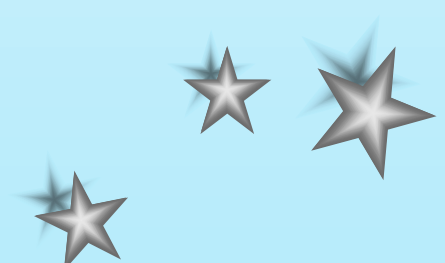
- **Federally-sponsored research has helped build the technology base on which the computing industry has grown.**
- **Fundamental research is key to stimulating innovation, and innovation is key to continued U.S. leadership in IT.**
- **Federal research funding complements, rather than preempts private research investments:**
 - The benefits of fundamental research are generally too distant and too uncertain to receive significant industry support.
- **Federal funding for research plays a critical role in educating students in the computing field.**





Government/Industry Roles in IT R&D

- **Federal investments support long-range fundamental research that industry cannot sustain**
 - High risk, innovative ideas whose practical benefits may take years to demonstrate
 - Directly support the education of the IT workforce professionals
- **The industrial R&D investment, though large in dollars, is different in nature:**
 - Research is focused on short-term – over 90% of IT R&D expenditures are for product development – typically 18 months product life cycle



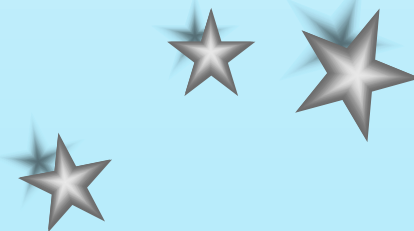


Information Technology – An Essential National Interest

Past Federal investments have yielded spectacular returns

- The Internet, the first graphical Web browser, advanced microprocessors
- IT now accounts for one-third of U.S. economic growth and employs 7.4 million Americans
- Business-to-consumer e-commerce is projected to grow to \$1.8 billion by 2002 (ITAA)
- The Internet has faster household penetration than telephone or television: 50 million Americans in five years
- Over 200 million people connected to Internet world-wide and is expected to reach 1 billion by 2005

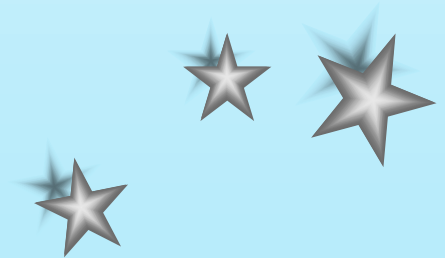
***We have an essential national interest in ensuring a continued
flow of good new ideas and trained professionals in
information technology***



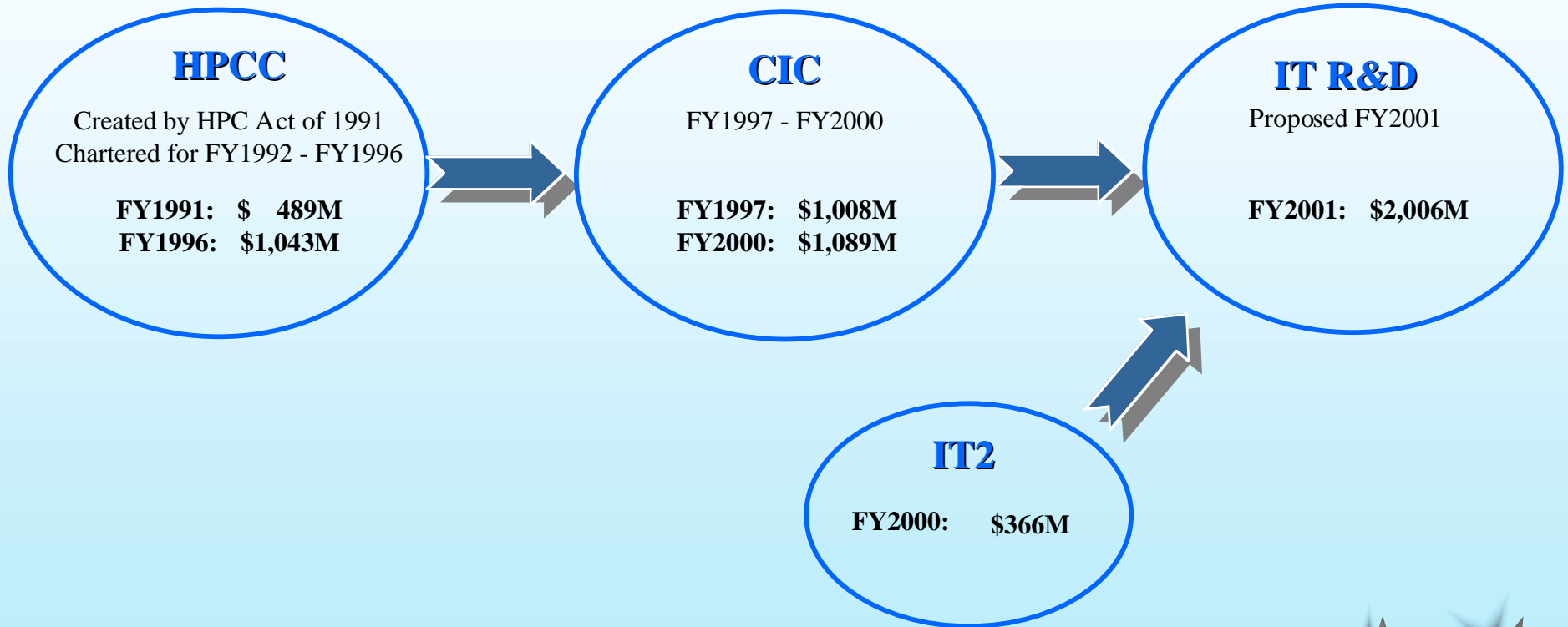


Information Technology R&D Program

- Evolved from the Federal HPCC and CIC
- Provides a mechanism for focused long-term interagency R&D in information technologies.
- \$2 billion multi-agency Information Technology R&D Program
 - 11 agencies and departments coordinated via a “virtual agency” coordination/management structure
 - Coordinated by the National Coordination Office for Information Technology Research and Development
- Assessed by the President’s Information Technology Advisory Committee.
- Includes the Next Generation Internet initiative and the Information Technology for the 21st Century (IT²) program.



From HPCC to IT R&D



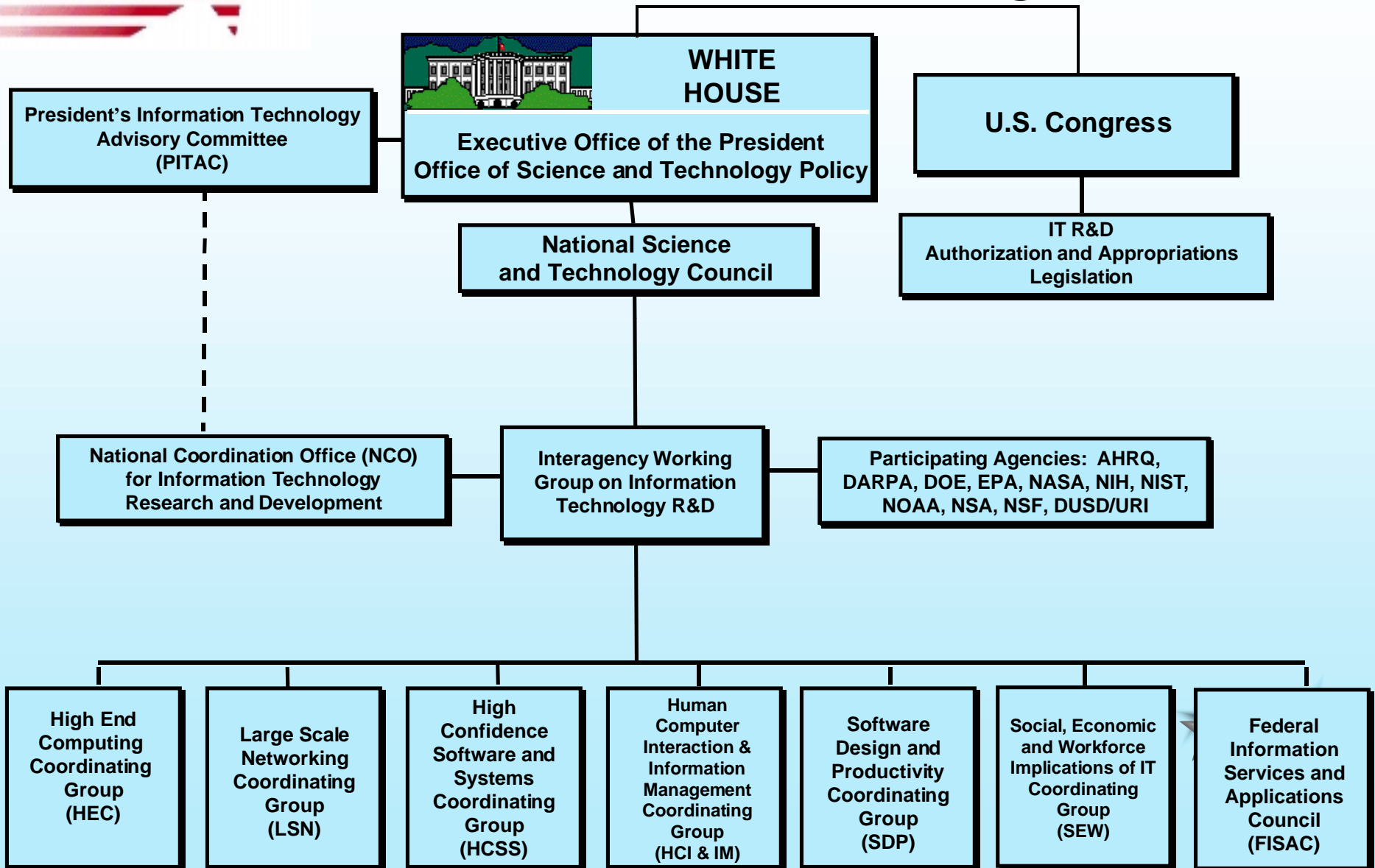


Participating Agencies and Departments

- Defense Advanced Research Projects Agency (DARPA)
- National Science Foundation (NSF)
- Department of Energy (DoE)
- National Aeronautics and Space Administration (NASA)
- National Institutes of Health (NIH)
- National Security Agency (NSA)
- National Institute of Standards and Technology (NIST)
- Office of the Secretary of Defense/University Research Initiative (OSD/URI)
- National Oceanic and Atmospheric Administration (NOAA)
- Environmental Protection Agency (EPA)
- Agency for Health Care Policy and Research (AHCPR)



Coordination of IT R&D Programs

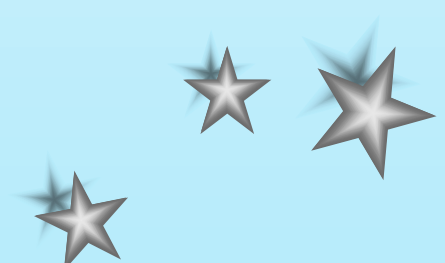




President's Information Technology Advisory Committee (PITAC)



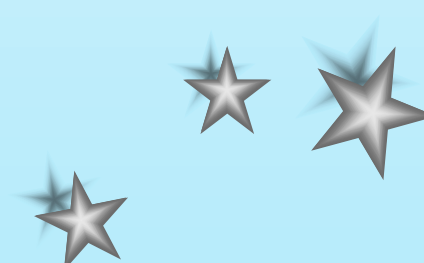
- Top IT experts from academia and industry.
- 23 members who advise the Administration on how to accelerate the development and adoption of information technologies.
- ***Information Technology Research: Investing in Our Future (1999).***
 - Recommended increasing strategic investments from \$1.46 billion in FY 2000 to \$2.83 billion in FY 2004.
 - Four priority areas for long-term R&D:
 - Software
 - Scalable information infrastructure
 - High-end computing
 - Socioeconomic impact





President's Information Technology Advisory Committee (PITAC) (Cont.)

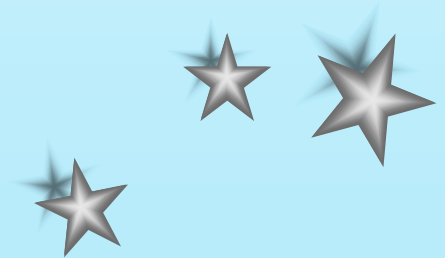
- **In 2000, three panel reports were released:**
 - *Resolving the Digital Divide: Information, Access and Opportunity*
 - *Transforming Access to Government through Information Technology*
 - *Developing Open Source Software to Advance High End Computing*
- **In 2001, three panel reports were released:**
 - *Transforming Health Care Through Information Technology*
 - *Using Information Technology To Transform the Way We Learn*
 - *Digital Libraries: Universal Access to Human Knowledge*
- **PITAC's 2001 Agenda:**
 - National Security
 - Individual Security





Interagency Working Group on IT R&D

- Provides coordination, planning, budgeting, and review of multi-agency IT R&D Program
- Provides technical assistance to the President's Information Technology Advisory Committee (PITAC)
- Membership consists of representatives from eleven agencies/departments, OSTP, and OMB
- Oversees activities of six Program Component Area (PCA) Coordinating Groups and the Federal Information Services and Applications Council (FISAC)
- Coordinates planning activities with OSTP and budget activities with OMB
- Chaired by Ruzena Bajcsy, Ph.D. (NSF)





IT R&D Coordinating Groups

- **Six Program Component Areas (PCAs)**

- High End Computing (HEC)
- Large Scale Networking (LSN)
- High Confidence Software and Systems (HCSS)
- Human Computer Interaction and Information Management (HCI & IM)
- Software Design and Productivity (SDP)
- Social, Economic and Workforce Implications of IT and IT Workforce Development (SEW)

- **PCA Characteristics**

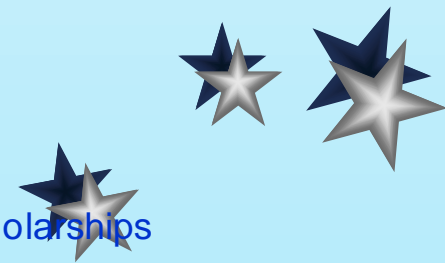
- PCAs span technical areas with multiple agencies' involved
- Each PCA includes hardware, software, algorithms, and applications
- Each CG focuses on specific R&D goals, identifies adequate investments, and maintains necessary budget visibility
- Technology R&D may span PCAs
- Applications span PCAs





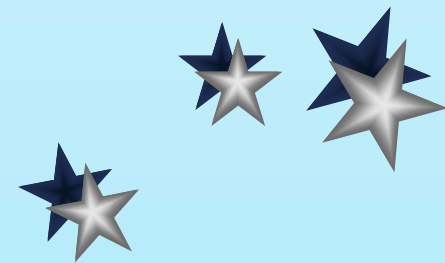
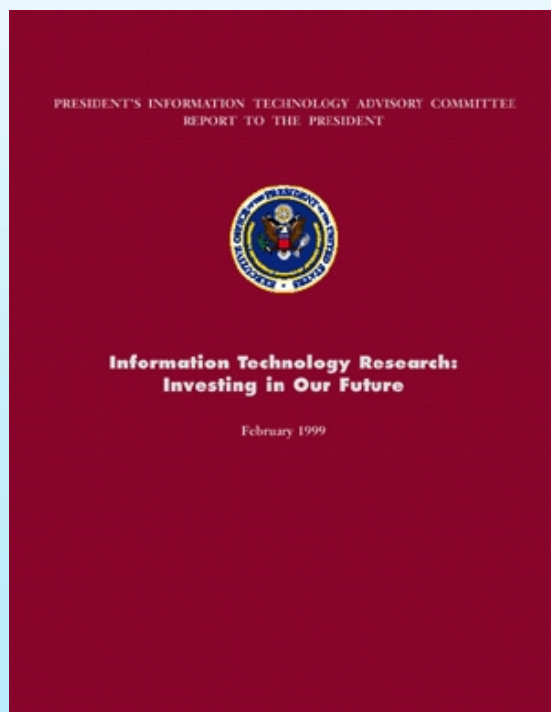
IT R&D Program Component Areas (PCAs)

High-End Computing (HEC)	<ul style="list-style-type: none">• State of the art in computing systems, applications, and high-end infrastructure• Advanced architectures• Mass storage
Large Scale Networking (LSN)	<ul style="list-style-type: none">• Advanced network communications that are scalable, reliable and secure• Software for efficient development and execution of scalable distributed applications
High Confidence Software & Systems (HCSS)	<ul style="list-style-type: none">• System reliability -- “no surprise software”• Security and privacy
Human Computer Interaction & Information Management (HCI & IM)	<ul style="list-style-type: none">• Knowledge repositories and information agents• Collaboratories• Systems to enable multi-modal human-system interactions• Virtual reality environments
Software Design and Productivity (SDP)	<ul style="list-style-type: none">• Software engineering of complex systems• Active software• Component-based software design• Networked embedded systems
Social, Economic and Workforce Implications of IT and IT Workforce Development (SEW)	<ul style="list-style-type: none">• Application of interdisciplinary research• Curriculum development, fellowships, and scholarships• R&D in information-based learning tools, lifelong learning, and distance learning





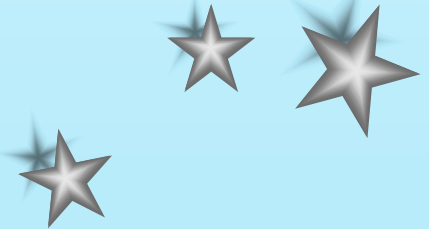
**February 24, 1999 Report to Congress,
“Information Technology Research:
Investing in Our Future” the PITAC provided
IT R&D priority recommendations to the
Interagency Working Group**





PITAC Recommendations Impact PCA Framework

- **The investment in High End Computing and Computation is now reported as two new PCAs to better characterize the breadth of the investment.**
 - High End Computing Infrastructure and Applications (HEC I&A)
 - High End Computing Research and Development (HEC R&D)
- **Human Computer Interaction and Information Management (HCI & IM) succeeds the Human Centered Systems (HuCS) PCA, reflecting the increasing challenges of making large amounts of information easily available and useful to the widest variety of users.**
- **Large Scale Networking (LSN) activities include the Next Generation Internet (NGI) Initiative and scalable information infrastructure R&D.**
- **Software Design and Productivity (SDP) was a new PCA in FY 2000, established in response to the PITAC's finding that not only is the demand for software exceeding our ability to develop it, but the software produced today is difficult to design, test, maintain, and upgrade.**





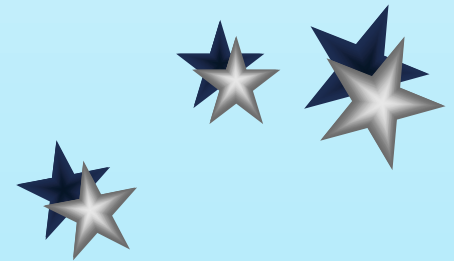
PITAC Recommendations Impact PCA Framework (Cont.)

- **High Confidence Software and Systems (HCSS) was formerly the High Confidence Systems (HCS) PCA. Its new name and scope reflect the increasing need for adaptability, reliability, safety, and security in both the software and the systems that U.S. citizens count on each and every day.**
- **Social, Economic, and Workforce Implications of IT and IT Workforce Development (SEW) is the successor to the Education, Training, and Human Resources (ETHR) PCA. SEW's expanded R&D portfolio now includes assessment of the social and economic consequences of IT's transforming influence on the workplace as well as expanded research in education and worker training issues resulting from the rapid U.S. move to an information-based economy.**





**In each of these major research
areas, PITAC offered specific
recommendations. . .**





High-End Computing

PITAC Recommendations -

- Fund R&D on software to improve the performance of high-end computing.
- Drive high-end computing research by trying to attain sustained petaops/petaflops on real applications by 2010 through a balance of software and hardware strategies.
- Fund the acquisition of the most powerful high-end computing systems to support scientific and engineering research.
- Expand the NSTC CIC High-End Computing Working Group's coordination process to include all major elements of the government's investment in high-end computing.
- Increase funding for high-end computing R&D and acquisitions: add \$270M in FY2000 ... add \$430M in FY2004.

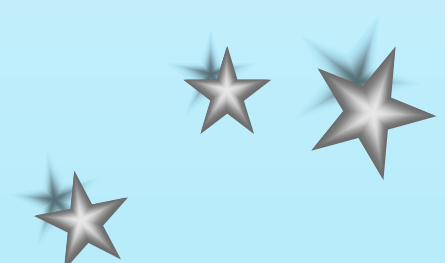




High-End Computing

Accomplishments -

- Overall funding in high-end computing has increased:
 - Budgets have increased
 - New NSF-sponsored Information Technology Research program
 - Instrumental in attracting and retaining talented researchers
- Novel and innovative architectures for high-end computing are being aggressively explored on several fronts:
 - Cluster computing
 - High performance computing and storage devices
 - Very Large Scale Integration (VLSI) of photonics for intra-chip and inter-chip communications
 - Development of three-dimensional multi-chip modules





High-End Computing

Accomplishments (continued) -


- Development of optical tape technologies that can store one terabyte of information on a single, standard, hand-held tape cartridge
- R&D in software for high-end computing has increased significantly within Federal government
 - System-level software (which performs resource allocation, management and control)
 - Software support (such as reusable software libraries) common to many applications
 - Applications algorithms
- New system has been installed at the DOE's ASCI facility at Lawrence Livermore National Laboratory. Dubbed "Baby Huey," this is a scalable prototype for a 10-teraops system that will be the fastest computing platform in the world





Scalable Information Infrastructure (SII)

PITAC Recommendations -

- Fund research in the behavior of the global-scale network and its associated information infrastructure.
 - Support research on the physics of the network, including optical technologies, wireless technologies including satellites, wired technologies including cable and related bandwidth issues.
 - Support research to anticipate and plan for scaling the Internet.
 - Support research on middleware that enables large-scale systems.
 - Support research on large-scale applications and the scalable services they require.
 - Fund a balanced set of testbeds and research infrastructure that serve the needs of networking research as well as research in enabling information technologies and advanced applications.
 - Increase funding for SII R&D: add \$60M in FY2000 ... add \$300M in FY2004.
- 



Scalable Information Infrastructure

Accomplishments -

- LSN agencies fund multiple research projects on:
 - Performance measurement and modeling
 - Dynamically managing and reconfiguring large-scale networks
 - Management of networks to improve application performance and tuning of protocol stacks
 - Optical networking technologies and management
 - Wireless technologies
 - Satellite technologies
 - Hybrid technologies
 - Scalable services for global network
 - Quality of Service
 - Sensornet





Scalable Information Infrastructure

Accomplishments (continued) -

- Automated discovery
- Security and information assurance
- Atmospheric fluid dynamics
- Development of the 100 X testbed and the 1000 X testbed (Supernet) to support applications development and networking research





Software

PITAC Recommendations -

- Make fundamental software research an absolute priority.
- Make software research a substantive component of every major information technology research initiative.
- Fund more fundamental research in software development methods and component technologies.
- Support fundamental research in human-computer interfaces and interaction.
- Fund more fundamental research in information management technologies to (1) capture, organize, process, analyze, and explain information, and (2) make information available for its myriad uses.
- Increase funding for software R&D: add \$112M in FY2000 ... add \$540M in FY2004.





Software

Accomplishments -

- All areas in 1999 PITAC report are being funded:
 - Component-based software design
 - Technologies for automated analysis, simulation, and testing of components and systems
 - A library of certified domain-software components
 - Predictable, reliable, and secure components and systems
 - Technologies for interoperable distributed applications
- NSF, the major new funder of software research, has explicitly implemented the PITAC's recommendations in its Information Technology Research (ITR) initiative. Specifics include
 - Larger individual grants
 - Support for more researchers
 - Support for thematic programs





Software

Accomplishments (continued) -

- Much of the increased funding is devoted to human-computer interfaces and interaction
 - Virtual reality and virtual environments
 - Enabling technologies and applications
 - Faster computations/hardware developments to update visualizations
 - Haptic devices, CAVEs, etc.
 - Training for the military, NASA mission rehearsal, flight simulation, fire fighting, police training, piloting ships and submarines (generally rare and dangerous scenarios)
 - Distance education, training, learning

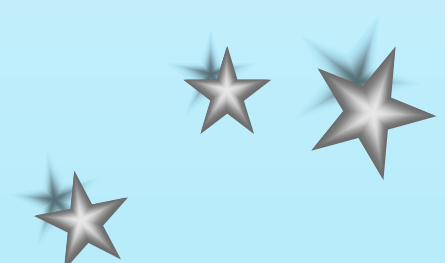




Software

Accomplishments (continued) -

- Universal access
 - Developing technologies for military applications, realizing that they are directly applicable to people with disabilities (e.g., DARPA is developing hands-free situational awareness tools for soldiers in remote battlefields and translingual multimedia information retrieval)
 - Multi-agency Digital Libraries initiative continues and is expanded. They are addressing:
 - Digital library collection building, management, and dissemination responsibilities
 - Information storage, current analysis, and retrieval





Social, Economic & Workforce (SEW) Issues

PITAC Recommendations -

- Expand Federal research into policy issues arising from information technology.
- Fund information technology research on socioeconomic issues.
- Expand the participation of underrepresented minorities and women in computer and information technology careers.
- Create programs that remove the barriers to high bandwidth connectivity posed by geographic location, size, and ethnic history of research, educational institutions, and communities.
- Accelerate and expand education in information technology at all levels K-12, higher education, and lifelong learning.
- Strengthen the use of information technology in education.
- Increase funding for SEW R&D: add \$30M in FY2000 ... add \$100M in FY2004.





Social, Economic & Workforce Issues

Accomplishments -

- In FY2000, NSF funded the Computer Science and Technology Board of the National Research Council to study:
 - Issues in ownership of the electronic forms of creative “products” such as writing, music, and software
 - Report “The Digital Dilemma: Intellectual Property in the Information Age”
- In FY2000, NSF launched ITR program funding in the following areas:
 - Development of new data and indicators for tracking IT
 - Causes and effects of unequal participation in IT by different social groups
 - Interdependence of technologies, institutions, and communities
 - Impacts of IT on laws, ethics, and social norms
 - Research methods for studying its socioeconomic impacts
 - Interdependence of IT, computerized groups, institutions, and communities, including social, political, and legal outcomes

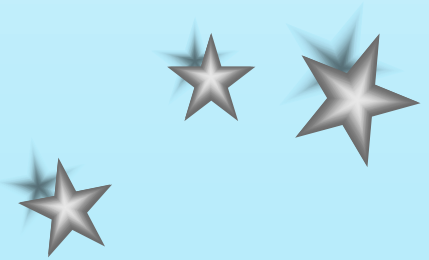




Social, Economic & Workforce Issues

Accomplishments (continued) -

- NSF funds studies of participation of minorities and women in IT careers
- In FY2001, NSF is funding research in:
 - IT workforce development
 - Social and economic implications of IT
 - Universal access
 - Infrastructure extensions to expand the community
- NSF sponsored research directed specifically at education and workforce issues including:
 - Methods to increase IT literacy and skills
 - Human learning both individually and in groups
 - Integration technology in learning environments
 - Use of digital libraries in education
 - Education and learning across cultural and social differences





Next Generation Internet Initiative Explores Tomorrow's Networks and Applications

- Presidential Initiative begun 1998
- Approximately \$100M per year
- Six agencies funded directly
 - DARPA, NSF, DOE, NASA, NIH, NTIA
- Several other agencies collaborate
- Cooperation with university-based Abilene Internet 2 program
- See www.itrd.gov, www.ngi.gov and www.internet2.org





PITAC Review and Impact of NGI

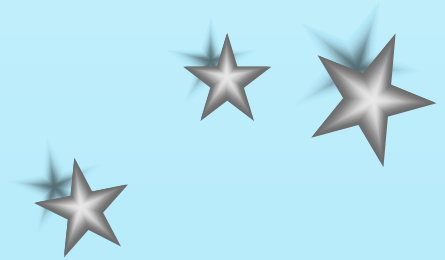
- **Legislatively mandated review by PITAC.**
- **PITAC findings about the NGI:**
 - The NGI Program has made excellent progress
 - “More applications should be funded that demonstrate the utility of the NGI’s gigabit bandwidth to end-users, its increased security, and its expanded quality of service”
 - Federal agencies should provide more capability to measure network performance
 - Congress should consider additional funding for a program where the NGI research institutions act as aggregators and mentors for nearby smaller or disadvantaged institutions.
- **Impact:**
 - PITAC findings contributed to continued funding of NGI
 - Federal agencies significantly increased the funding of NGI applications
 - NGI agencies funded performance measurement of NGI networks
 - NGI agencies funded Educause to assist smaller institutions in taking advantage of high performance networking





Examples of Industry Involvement

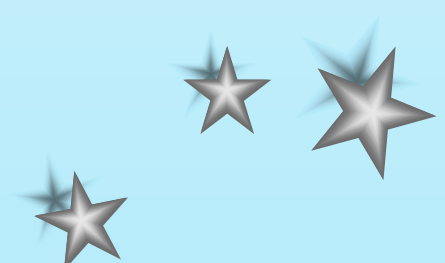
- **Federal agencies contract with the commercial sector for research and development**
 - Intel, Sun and others are developing an automatically tuned application/network interface.
 - Ciena and others are developing key optical networking components.
- **Federal agencies purchase network services from commercial providers, giving the providers direct experience with high-performance networking. Providers contribute significant services and equipment (value is many times the Federal contribution)**
 - vBNS network (NSF) is provided by Worldcom
 - DREN is provided by AT&T
 - ESnet is provided by Qwest
 - NREN is provided by Sprint





Industry Involvement (Cont.)

- **Commercial sector participates directly in Federally funded testbeds, e.g. Quality of Service Backbone network (Qbone) participants include NASA, NSF, DoD, Internet2, Cisco, Spirent, Torrent/Ericsson, and Nortel. The commercial sector provides services and equipment for testing.**
- **The commercial sector participates in the Joint Engineering Team (JET) that architects the NGI: Cisco, Qwest and Worldcom.**

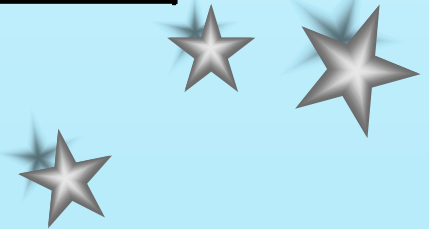




Agency IT R&D Budgets by PCA

FY 2001 Budget Request (dollars in millions)

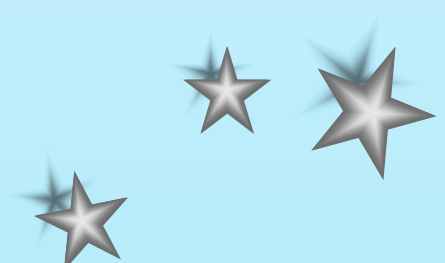
Agency	HECC	HCI&IM	LSN	SDP	HCSS	SEW	Totals
NSF	387.3	135.8	111.2	39.5	20.5	45.3	740
DARPA	111.1	48	85.3	55	8	0	307
NASA	154.9	17.9	19.5	20	9.1	8.3	230
NIH	37.9	99.6	65.6	.7	6.5	7	217
DOE	136.5	16.6	32	0	0	4.6	190
NSA	32.9	0	1.9	0	44.7	0	80
NIST	3.5	6.2	4.2	2	8.5	0	24
NOAA	15.1	.5	2.7	1.5	0	0	20
AHRQ	0	8.1	7.4	0	0	0	16
OSD/URI	2	2	4	1	1	0	10
EPA	3.6	0	0	.6	0	0	4
Totals	884.8	334.7	333.8	120.3	98.3	65.2	1838





Summary

- **PITAC has raised awareness of the critical need for increased Federal IT funding.**
- **PITAC has directly influenced the agencies' research programs to be more aligned with future industry and mission needs.**
- **PITAC has been a mechanism for educating industry about the resources available in the Federal IT R&D Program.**





For Further Information on Federally Funded IT R&D

Contact us at:

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www.itrd.gov
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